Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. - SEMESTER – II • EXAMINATION – SUMMER • 2013

Subject code: 1724707 **Date: 05-06-2013**

Subject Name: Mechatronics Signal Processing

Time: 10.30 am – 01.00 pm **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q:1 Perform the circular convolution of signal $x_1(n) = \{2,1,2,1\}$, $x_2(n) = \{1,2,3,4\}$, 0Ò n Ò3 using DFT and IDFT. **14**

Q:2 **(a)** Compute the inverse Z transform by partial fraction for the following Z transform: **07**

$$X(Z) = \frac{Z(Z^2 + 2Z)}{(Z+2)(Z^2 + 4Z + 5)}$$

(b) Prove that the following discrete ï time system is nonlinear system **07**

$y(n) = x^2(n) - x(n-1)x(n+1)$

OR

(b) Derive the relationship between Z transform and DFT. **07**

Q:3 **(a)** Explain the various properties of DFT. With suitable example discuss any one of them. **07**

(b) Discuss the bandpass sampling of band limited signal centered at f_c = 20 MHz with band width 5 MHz. **07**

OR

Q:3 Perform a 8 point DFT on a continues input signal x(t), for sampling frequency of 8000 samples/second. **14**

$$x(t) = \sin(2\pi \bullet 1000 \bullet t) + 0.5\sin(2\pi \bullet 2000 \bullet t + 3\pi/4).$$

Also prove that the IDFT of your DFT gives original time domain signal.

Q:4 **(a)** Find the position of poles, zeros, region of convergence and Z transform for the following: **07**

$$x(n) = (0.3)^n u(n) + (-0.2)^n u(n)$$

(b) Find the response of forced vibration of a single degree of freedom system (LTI system). **07**

OR

Q:4 What do you understand by FFT? Explain the various steps to compute the FFT of eight point sequence. **14**

Q:5 **(a)** Discuss the design of Linear ï Phase FIR filter using windows. **07**

(b)

1. Why the Digital Signal Processing is important for Mechatronics Engineers? **03**

2. Determine even and odd part of the following continuous time signals: **04**

    a. $x(t) = e^{-2t}\cos t$

    b. $x(t) = 5 + 3t + 4t^2$

OR

Q:5 Discuss the various techniques used to design discrete time IIR filters from continues time filters. **14**

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